The impact of the Russian Aggression against Ukraine on the Russia-EU Trade

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Abstract

This paper intends to establish conceptual foundations for analyzing the economic dimensions of a territorial military conflict. The Intraregional Trade Disruption from War Simulator (ITDW-Simulator) attempts to estimate the heterogeneous macroeconomic effects of the military conflict. The model suggests two primary indicators and four secondary indicators. The final trade suffocation index ($_{TS-Index}$) and the final investment desgrowth from war function ($-\delta_w$) measure trade disruption's potential impact on international trade patterns and economic development. The agriculture exports, industrial and manufacturing exports, service exports, and FDI flows capture the trade and investment interdependency. The model investigates the impact of the Russo-Ukraine military conflict on the bilateral trade and investment between the Russian Federation and the European Union.
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"A nation that is boycotted is a nation that is in sight of surrender. Apply this economic, peaceful, silent, deadly remedy,and there will be no need for force. It does not cost a life outside the nation boycotted, but it brings pressure upon the nation which, in my judgment, no modern nation could resist."

President Woodrow Wilson[1] (1919)

1. Introduction

Europe experienced a series of unprecedented events at the start of 2022. On February 21, 2022, the Russian government recognized the independence of disputed Ukrainian territories in Donbas, namely, the Donetsk People's Republic (DPR) and the Luhansk People's Republic (LPR). Under the Doctrine of humanitarian intervention,[2] the Russian government proceeded with deploying the build-up of armed forces positioned around Ukraine's borders at the beginning of the year. Invasion troops initially moved to the self-proclaimed separatist in Eastern Ukraine. They then targeted major cities and their infrastructure across Ukraine, including Berdyansk, Chernihiv, Kharkiv, Odesa, Sumy, and the capital Kyiv. At the moment of writing, the epicenter of the invasion is limited to Eastern Ukraine (Office of the high Commisioner for human rights, 2022).

One hundred forty-one countries voted in the U.N. General Assembly resolution condemning the Russian invasion in Ukraine and demanded the immediate and complete withdrawal of the invasion troops from Ukrainian territory (see Figure 1). The international outcry about the Russian invasion was followed by the quick official response of the international organizations. The United Nations (UN) and the North Atlantic Treaty Organization (NATO) also expressed disapproval of the unjustified Russian invasion in Ukraine. They recommended the diplomatic resolution of the Russo-Ukraine conflict. The European Union (EU) and the Group of Seven (G7) imposed unprecedented sanctions on the Russian Federation, leading the Russian economy on the verge of a recession.

Indeed, sanctions set a chain of events in the Russian economy. In the macroeconomic context, the ban of the Russian Federation from the SWIFT financial messaging system[3] excluded the Russian economy from international financial transactions. The response of the financial markets το SWIFT sanctions was immediate (Congressional Research Service, 2022). The Russian central bank announced foreign exchange interventions to support domestic bank liquidity (Central Banking Newsdesk, 2022). The temporary ruble devaluation raised imports' domestic prices (BBC News, 2022).

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[1] These views were reflected in the legal structure of the League of Nations, which gave prominence to the collective use of economic sanctions as a means of deterring aggression (Hufbauer, Schott, Elliott, & Oegg, 2007).

[2] Humanitarian intervention is the use or threat of military force by a state (or states) across borders with the intent of ending severe and widespread human rights violations in a state which has not given permission for the use of force. Humanitarian interventions are aimed at ending human rights violations of individuals other than the citizens of the intervening state. Humanitarian interventions are only intended to alleviate the worst forms of suffering, which means that peacekeeping, peace-building and development aid do not fall under the definition of a humanitarian intervention (Seybolt, 2007).

[3] The Society for Worldwide Interbank Financial Telecommunication, or SWIFT, is a cooperative of financial institutions formed in 1973 with headquarters in Belgium. It is overseen by the National Bank of Belgium in partnership with other major central banks, including the U.S. Federal Reserve System, the Bank of England and the European Central Bank (Ortiz, 2022).

Figure 1. Where Russia's Attack on Ukraine Was Condemned.
Source: (Buchholtz, 2022).

The central bank counteracted and imposed capital controls by doubling its benchmark interest rates to control currency depreciation and hyperinflation (Verma, 2022). Empirically, currency devaluation in developing countries has a contractionary effect in the short run and an expansionary impact in the long run (Connolly, 1983; Gylfason & Risager, 1984; Gylfason & Schmid, 1983). However, ruble devaluation will have a neutral effect on Russian exports. The United States banned Russian energy-related imports, followed by the European Union.[4] The indefinite suspension of business operations for more than 750 international companies in Russia will further trade contraction. Trade disturbances consequently affected the Russian industry. One after the other, Russian factories suspended their operations due to shortages in raw materials and no access to parts and supplies. This synchronized shutdown of the factory production lines implies sharp cutbacks and sizeable output contraction with imminent repercussions on economic activity. The International Monetary Fund (IMF) projected that the synchronized decline of industrial production, consumption, and investment would lead to an economic contraction of 8.5%, an inflation jump to 8.5%, and a doubled-rate unemployment increase of 9.6% (Congressional Research Service, 2022).

The double-edged sword of the European Union sanctions may also disproportionately affect the European economies. Figure 2 reflects the trade flows between European Union and the Russian Federation from 2011 to 2021. In 2021, the bilateral trade and Investment flows amounted to €257.5 billion and to €447.4 billion, respectively. The European Union recorded a trade deficit with Russia of € 89 billion in 2011 that narrowed sharply to € 69 billion in 2021, indicating a significant drop of approximately 22.5% points (European Commission, 2022b). Despite the Russia Federation's accession to the World Trade Organization (WTO) in 2012, the government's import substitution policies contravened WTO regulations and policies. European Union filed six disputes at the WTO against Russia Federation's import restrictions[5]: recycling fee on imported vehicles (2013); import duties (2014); anti-dumping policies on small-sized vehicles (2014); an embargo on pig meat due to strict sanitary policies (2014); SOE procurement (2021); and wood exports (2022) (European Commission, 2022a). The aforementioned underlying tensions between EU-Russia explain to a great extent the last decade's bilateral trade's declining trend and the European Union's consideration of reducing the union's dependency on Russian imports in the context of national security (Gontmakher, 2021).

This paper suggests an analytical framework for estimating the economic consequences of military aggression. The Intraregional Trade Disruption from War Simulator (ITDW-Simulator) attempts to estimate the heterogeneous macroeconomic effects of the military conflict. The model suggests two primary indicators and four secondary indicators. The final trade suffocation index ($T_{S-Index}$) and the investment desgrowth from war function ($-\delta_w$) measure trade disruption's potential impact on international trade patterns and economic development. The agriculture exports, industrial and manufacturing exports, service exports, and Foreign Direct Investment (FDI) flows capture the trade and investment interdependency. The model investigates the impact of the Russo-Ukraine military conflict on the bilateral trade and investment between the Russian Federation and the European Union under a new perspective within

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[4] European Union intends to ban Russian oil and gas imports by the end of year, however, Eastern European countries are opposed to that possibility (Mellor, May 4, 2022).

[5] Russia has also filed four disputes at the WTO against the EU: on the EU's third energy package (2014), on gas cost-adjustment in EU anti-dumping investigations (2013 and 2015), and on EU anti-dumping measures on imports of certain cold-rolled flat steel products from Russia (2017)(World Trade Organization, March 16, 2020).
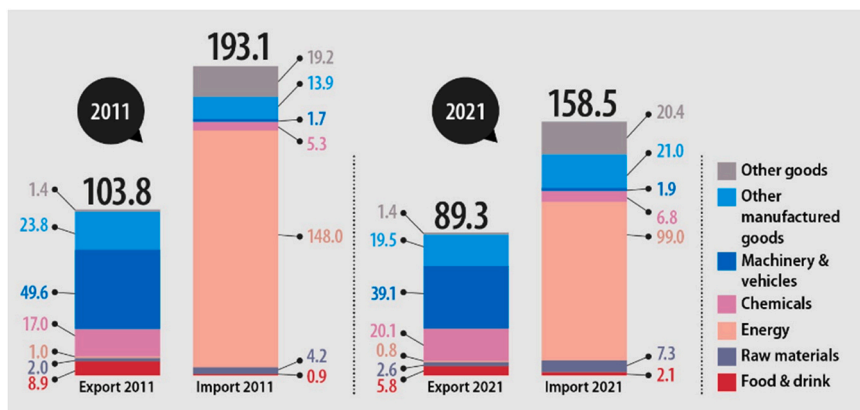
Figure 2. EU trade with Russia by product group, 2011 and 2021 (€ billion).
Source: (Eurostat, 2022).

the framework of a *Dynamic Imbalanced State* (DIS) (Mario Arturo Ruiz Estrada & Yap, 2013) and the *Omnia Mobilis* assumption (Mario Arturo Ruiz Estrada, 2010, 2011a, 2011b, 2017).

The paper is organized as follows. Section 2 offers an overview of the relevant literature. Section 3 describes the underlying model. Section 4 concludes.

2. Relevant literature

The debate on sanctions' efficacy as a foreign policy tool has become a prominent theme in public policy, and its use has been as frequent as it has been diverse (Brzoska, 2015; Cotright & Lopez, 2018; O'Sallivan, 2010). Relevant literature showed that sanctions could be considered an effective policy tool[6] (Doxey, 1987; Galtung, 1967; Ninsic & Wallenstein, 1983; Nossal, 1989) in accomplishing different policy objectives (Daoudi & Dajani, 1983; Hoffmann, 1967; Wallenstein, 1968). Policy objectives can vary significantly in terms of behavior and international status of the sanctioned countries aligned with the structure and operation of the international system (Barber, 1979); and regarding foreign policy objectives that include compliance, subversion, deterrence, domestic symbolism, and international symbolism (Lindsay, 1986).

Sanctions imposed by international organizations are more effective than unilateral or multilateral sanctions imposed by states (Bapat & Morgan, 2009; Drezner, 2000, 2003; Early & Spice, 2015; Martin, 1992; Miers & Morgan, 2002). International organization-imposed sanctions are remedial and designed to deter future misconduct by sanctioned countries (Bapat & Morgan, 2009; Drezner, 2000; Martin, 1992). Indeed, sanctioned countries are prone to comply with sanction regulations susceptible to opportunity costs, such country's reputation and future conflict expectations (Drezner, 1998, 1999; Hufbauer et al., 2007; Whang, 2010).

Sanctioned states will seek alternative markets to shift trade and investment flows to restore trade stability at the pre-sanction trade levels (Early, 2009, 2015; Lektzian & Biglaiser, 2013b;

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[6] According to the latter view, sanctions are successful tools about 35% of the time (Hufbauer et al., 2007; Morgan, Barat, & Kobayashi, 2014)

Peksen & Peterson, 2016). The absence of alternative markets will put significant economic pressure, threatening the economic and political autonomy of the sanctioned country (Adam & Tsarsitalidou, 2019; Early & Spice, 2015; Early, 2011, 2015; Peksen & Drury, 2010; Peksen, 2009; Wood, 2008). Notwithstanding, a sanctioned country's economic state is irrelevant to its policy decision-making behavior on economic sanctions (Bapat, Heinrich, Kobayashi, & Morgan, 2013; Dashti-Gibson, Davis, & Radcliff, 1997; Drury, 1998; Jeong & Peksen, 2019; Whang, 2010).

Empirical evidence shows that the economic impact of sanctions varies by the degree of success or failure on the sanctioned country (Baldwin, 1985; Bonetti, 1998; Drezner, 2000; Hufbauer, Schott, & Elliott, 1990; Martin, 1992; Mastanduno, 1999; Pape, 1997; Van Bergeijk, 1989). Sanction costs vary between santioner countries, even across different sectors imposed by the same sanctioner country (Botterill & McNaughton, 2008). It is a plausible conjesture that the higher deadweight welfare loss for the sanctioned country, the higher the probability of change its compliance behavior (Black & Cooper, 1987; Caruso, 2003; Giumelli, 2011).

The literature strand places the adverse effects of economic sanctions nearly to all economic activity. In the macroeconomic context, sanctioned countries experienced loss in the gross domestic product (GDP) and the gross national product (GNP) (Drezner, 2000; Gharehgozli, 2017), or the GDP growth rates (Neuenkirch & Neumeier, 2015). Sanctions influence international finance flows (Besedes, Goldbach, & Nitsch, 2017), harbinger of currency crises (Dreger, Kholodilin, Ulbright, & Fidrmuc, 2016; Peksen & Byunghwan, 2015), and volatile financial markets (Ankudinov, Ibragimov, and Lebedev 2017).

A sharp decline of production affects future capital and inflows and outflows. A shift in investor sentiment reflects the higher business risk expectations due to trade and investment restrictions (Gurvich & Prilepsky, 2015; Yang, Askari, Forrer, & Teegen, 2004). FDI flows can also decrease at the threat sanction imposition stage and return to initial levels when the sanctions are in place (Biglaiser & Lektzian, 2011). Neighbor states may substitute a sanctioned country's lost FDI flows by the sanctioner when the sanction period ends (Lektzian & Biglaiser, 2013a). Alternatively, sanctions may have no impact on the FDI flows irrespective their type, magnitude, and intensity (Shin, Choi, & Luo, 2015).

The disruption of trade flows triggers major shortages in the complex food value chain: production, processing, packaging, storage, transportation, and retail sales. In turn, manufacturing will result excessive logistical costs, and high risk premiums due to missed delivery deadlines and damaged goods (Van Bergeijk, 1995). In the absence of alternative supply chains, sanctioned countries will switch to cheaper alternatives buying low quality products (Amuzegar, 1997). Exports will be subject to sunk costs at the post-sanction period since it will take time for the broken trade relationship to be restored (Evenett, 2002).

Sanctions also extend to human mobility restrictions that can severely affect tourism, entertainment, and healthcare dependent economies (doxey, 1980). Logically, some sectors may benefit, such as ecommerce and food retail that will offset economic damages.

3. The model

The *Intraregional Trade Disruption from War Simulator (ITDW-Simulator)* is based on an inter-linkage coordinate space (Mario Arturo Ruiz Estrada, 2017). The multi-dimensional representation of endogenous and exogenous variables depicts the simultaneous strategic interactions between involved parties within differential formations in space and time, which a two-dimensional Euclidean plane fails to capture (M. A. Ruiz Estrada, 2009; Mario Arturo Ruiz

Estrada, 2017). The calculation of the ITDW-Simulator is a three-step process. The first step is to build the trade suffocation index ($T_{S-Index}$). The second step is the construction of the investment desgrowth ($-\delta_w$) from war function for each of the eight regions. The last step integrates the right ($-\delta_w$) functions on a single surface. The ITDW-Simulator aims to investigate the trade and investment flows pre-sanction and post-sanction states of the involved countries. This comparative assessment provides information about the reorganization of the affected regions to restore their pre-embargo equilibria.

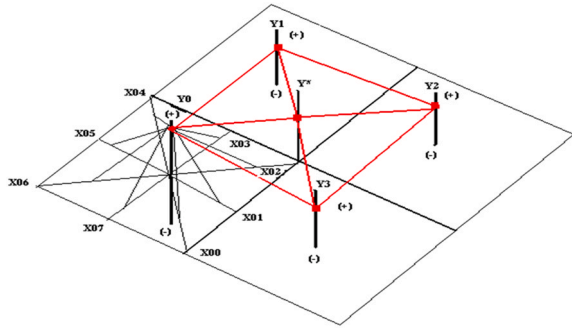### 3.1. Trade suffocation & investment desgrowth

Trade Suffocation is "full or partial trade and investment sanctions imposed by a nation or a group of nations on another country to punish for its belligerent behavior toward a nation or group of nations that endanger international peace and security." The main arguments for imposing trade suffocation are (i) invasion of sovereignty; (ii) abuse of power and use of violence on the civil society across international or neighbor's borders according to the international law, and (iii) the human and material damages in massive attacks under different levels". Trade suffocation has a direct impact on economic performance. Authors proposed *investment desgrowth*, an indicator to measure the economic effect of trade suffocation. This indicator can reveal the various leakages that derive from the trade suffocation and adversely affect any country's trade and investment.

The following expression calculates the trade suffocation index ($T_{S-Index}$)

$$T_{S-Index} = \frac{[X_{t_1} - X_{t_0}] + [FDI_{t_1} - FDI_{t_0}]}{[GDP_{t_1} - GDP_{t_0}]} \times 100\%$$

(1)

and corresponds to the differential annual changes of the exports and foreign direct investments to the gross domestic product in real prices. The starting point is the pre-sanction equilibrium, and the trade indicator is contingent on correction adjustments in the trade and investment flows during the war period. The $T_{S-Index}$ reveals the country's trade dependency levels in the absence of alternative supply chains: (i) When $T_{S-Index}$ is negative, the levels of trade dependency are high, so the economy is not autarkic; (ii) When $T_{S-Index}$ is positive, the economy is self-sufficient, and it can restore trade stability at the pre-embargo levels; and (iii) when $T_{S-Index}$ is zero, it is an indicator of balanced economic growth; economic sanctions have zero impact on the domestic economy.

Investment desgrowth ($-\delta_w$) is based on the concept of economic desgrowth ($-\delta$) (M. A. Ruiz Estrada, 2010, 2011a, 2011b). The economic desgrowth ($-\delta$) analyzes how controlled and non-controlled shocks can adversely affect full potential gross city product (G) in the short run. Economic desgrowth ($-\delta$) is defined "as an indicator that can show different leakages that is originated from controlled and non-controlled events that can affect the performance of the final gross city product (G) formed in a period of one year"(Mario Arturo Ruiz Estrada & Koutronas, 2016). The model assumes that the world economy is constantly chaotic and susceptible to butterfly effects of initial-condition sensitivity (Gleick, 1988; LeBaron, 1994; Wilmott, 2009). Economic desgrowth employs systematic sampling to assess the systemic risk of macroeconomic events. Lorenz's transformation assumptions also facilitate the analysis of investment desgrowth. The calculation of income desgrowth is based on the *Omnia Mobilis* assumption (Mario Arturo Ruiz Estrada, 2010, 2011a, 2011b).

Figure 3. The Trade Suffocation Index ($T_{S\text{-Index}}$) and the Investment Desgrowth $(-\delta_w)$.
Source: Authors' elaboration.

Investment desgrowth corresponds to a country's exports and FDI losses in lieu of sanctions.[7] Disruption of trade flows will produce negative import and export supply shocks in the targeted economy, shifting the aggregate supply curve leftward with instant effects on output and employment in the short run. Import flow restrictions result in an upward adjustment of trade-related administrative costs, leading to demand-push inflation. Alternatively, domestic supply chains will experience output shortages in intermediate and final goods leading to cost-push inflation. A sharp decline in production will affect future capital and inflows and outflows, translating into high stock market volatility. Volatility shocks will affect economic activity by further declining investment, GDP, output, and employment. Double-impact inflation can emerge in circumstances of hyperinflation as the central bank has to choose between inflation targeting and economic growth. Demand may not be temporarily affected in anticipation of an armistice agreement. Even if an armistice agreement is accomplished, the government will not restore the pre-sanction trade levels for two reasons. First, the impact of sanctions on trade and investment flows is time-persistent. Even after many years, the economy cannot return to its pre-sanction levels, exacerbating the total costs. Second, economic sanctions affect not only the countries involved but also neutral countries, generating a negative externality (Glick & Taylor, 2010).

Empirical evidence shows that gradual unfavorable supply and demand shocks with medium- and short-term effects on output and employment characterize the episodes of financial crises. In the case of investment desgrowth, the impact of sanctions on economic activity differs in terms of magnitude and intensity: an economy experiences a supply shock in the short-run with instant effects on output and employment. In contrast to financial crises, the double impact on supply will contract imports and exports.

The $(-\delta_w)$ function consists of four sub-functions: agriculture exports (Y_0); industrial and manufacturing sector (Y_1); services sector (Y_2); and FDI flows mobility (Y_3). Each sub-function Y_{ij} is a single-variable quadrant vertically centered and linked ($\frac{\text{L}}{\text{F}}$)" to the dependent variables X_{ji} on the bottom part of the quadrant by horizontal lines (see figure 3). The multi-dimensional setting depicts the trade dynamics that involve interactions at the same and different embargo

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[7] Sanctions are penalties given to a country that is acting unruly or out of order. Sanctions will restrict a certain good or service like oil embargoes, financial transaction restrictions, and tariffs, to name a few. On the other hand, trade embargoes are a type of economic sanction which restricts or bans trade with one country. This is a full trade ban on all goods and services with exception humanitarian aid.

rate levels and timescales. Among the four quadrants, there exists a single axis which we call the final national output (Y*). The movement of the $(-\delta_w)$ function in time is under *Omnia Mobilis*, the "everything is moving" assumption (Mario Arturo Ruiz Estrada, 2010, 2011a, 2011b, 2017). This assumption enables the simultaneous observation of the co-movement of many variables within a multi-dimensional setting in contrast to the ceteris paribus assumption, which examines variables' behavior in isolation by keeping the other variables constant.

The $(-\delta_w)$ function is given by

$$-\delta_{w_0}|_{\maltese Y_0} = f(\maltese \Delta Y_{00}, \maltese \Delta Y_{01}, \maltese \Delta Y_{02}, ..., \maltese \Delta Y_{0\infty})$$

$$-\delta_{w_1}|_{\maltese Y_1} = f(\maltese \ \Delta Y_{10}, \maltese \ \Delta Y_{11}, \maltese \ \Delta Y_{12}, ..., \maltese \ \Delta Y_{1\infty})$$

$$-\delta_{w_2}|_{\maltese Y_2} = f(\maltese \ \Delta Y_{20}, \maltese \ \Delta Y_{21}, \maltese \ \Delta Y_{22}, ..., \maltese \ \Delta Y_{2\infty})$$

$$-\delta_{w_3}|_{\maltese Y_3} = f(\maltese \ \Delta Y_{30}, \maltese \ \Delta Y_{31}, \maltese \ \Delta Y_{32}, ..., \maltese \ \Delta Y_{3\infty})$$

$$\maltese = Real\ Time \quad Y_i = Output \quad \Delta = Dynamic\ Desgrowth\ Rate$$

$$(2)$$

The dynamic desgrowth rate is based on:

$$\maltese -\Delta X_{ij} = \frac{\maltese -\Delta X_{ij}|_{t_1} - \maltese -\Delta X_{ij}|_{t_0}}{\maltese -\Delta X_{ij}|_{t_0}} \times 100\%, \quad i$$

$$= \{1, 2, ..., \infty\}, \quad j = \{1, 2, ..., \infty\} \tag{3}$$

Then we can estimate the new equilibrium

$$\maltese \quad Y^* \equiv \maltese \pm Y_0 \text{⊥⊤} \maltese \pm Y_1 \text{⊥⊤} \maltese \pm Y_2 \text{⊥⊤} \maltese \pm Y_3 \tag{4}$$

The calculation of the agriculture, industrial and manufacturing, service sectors, and FDI flows are given by the (5), (6), (7), (8), (9), (10), (11) and (12) expressions. Suppose that $-\delta_{w_0}|_{\maltese Y_0}$ function shows that a region experienced a significant desgrowth followed by $(\maltese Y_{A-0:0_i}) \vee (\maltese Y_{B-0:1_i}) \vee (\maltese Y_{C-0:2_i}) \vee (\maltese Y_{Z-0:4_\infty})$. Then this region needs to reorganize the agriculture sector:

$$\maltese Y_{A-0:0_i}$$
$$= f(\maltese \Delta X_{A-0:00}, \maltese \Delta X_{A-0:01}, \maltese \Delta X_{A-0:02}, ..., \maltese \Delta X_{A-0:0\infty})$$

$$(5)$$

$$\maltese Y_{B-0:0_i}$$
$$= f(\maltese \Delta X_{B-0:00}, \maltese \Delta X_{B-0:01}, \maltese \Delta X_{B-0:02}, ..., \maltese \Delta X_{B-0:0\infty})$$

$$(6)$$

Similarly, if the $-\delta_{w_0}|_{\maltese Y_1}$ function shows that a region experienced a significant desgrowth followed by $(\maltese Y_{A-1:0_i}) \vee (\maltese Y_{B-1:1_i}) \vee (\maltese Y_{C-1:2_i}) \vee (\maltese Y_{Z-1:4_\infty})$. Then, this region needs to reorganize the industrial & manufacturing sector:

$$\maltese Y_{A-1:0_i}$$
$$= f(\maltese \Delta X_{A-1:00}, \maltese \Delta X_{A-1:01}, \maltese \Delta X_{A-1:02}, ..., \maltese \Delta X_{A-1:0\infty})$$

$$(7)$$

$$\maltese Y_{B-1:0_i}$$
$$= f\,(\maltese \varDelta X_{B-1:00},\ \maltese \varDelta X_{B-1:01},\ \maltese \varDelta X_{B-1:02}, ..., \maltese \varDelta X_{B-1:0\infty})$$

$$(8)$$

Consequently, if the $-\delta_{w_0}|_{\maltese\ Y_2}$ function shows that a region experienced a significant desgrowth followed by $(\maltese Y_{A-2:0_i}) \vee (\maltese Y_{B-2:1_i}) \vee (\maltese Y_{C-2:2_i}) \vee (\maltese Y_{Z-2:4_\infty})$. Then, this region needs to reorganize the services sector:

$$\maltese Y_{A-2:0_i}$$
$$= f\,(\maltese \varDelta X_{A-2:00},\ \maltese \varDelta X_{A-2:01},\ \maltese \varDelta X_{A-2:02}, ..., \maltese \varDelta X_{A-2:0\infty})$$

$$(9)$$

$$\maltese Y_{B-2:0_i}$$
$$= f\,(\maltese \varDelta X_{B-2:00},\ \maltese \varDelta X_{B-2:01},\ \maltese \varDelta X_{B-2:02}, ..., \maltese \varDelta X_{B-2:0\infty})$$

$$(10)$$

Finally, if the $-\delta_{w_0}|_{\maltese Y_3}$ function shows that a region experienced a significant desgrowth followed by $(\maltese Y_{A-3:0_i}) \vee (\maltese Y_{B-3:1_i}) \vee (\maltese Y_{C-3:2_i}) \vee (\maltese Y_{Z-3:4_\infty})$. Then, this region needs to reorganize the FDI flows:

$$\maltese Y_{A-3:0_i}$$
$$= f\,(\maltese \varDelta X_{A-3:00},\ \maltese \varDelta X_{A-3:01},\ \maltese \varDelta X_{A-3:02}, ..., \maltese \varDelta X_{A-3:0\infty})$$

$$(11)$$

$$\maltese Y_{B-3:0_i}$$
$$= f\,(\maltese \varDelta X_{B-3:00},\ \maltese \varDelta X_{B-3:01},\ \maltese \varDelta X_{B-3:02}, ..., \maltese \varDelta X_{B-3:0\infty})$$

$$(12)$$

The alignment of the four $(-\delta_w)$ functions lead to the final national output (Y*), which is graphically the horizontal-line connection of the four quadrants into a single surface. The final national output (Y*) outcome depends on the surface's location, and there are four locations.

If $+ \varDelta Y^* \cap \mathbb{R}_+ \Rightarrow$ surface $\equiv$ non-trade and investment desgrowth from war, then

$$\maltese \quad Y^* \equiv \maltese + Y_a \maltese + Y_b \maltese + Y_c \maltese + Y_z$$

$$(13)$$

If $\varDelta Y^* \cap 0 \Rightarrow$ surface $\equiv$ partial investment desgrowth from war, then

$$\maltese \quad Y^* \equiv \maltese + Y_0 = 0 \quad \maltese + Y_1 = 0 \quad \maltese \quad \maltese + Y_2$$
$$= 0 \quad \maltese + Y_3 = 0$$

$$(14)$$

If $\varDelta Y^* \cap \mathbb{R}_{+/-} \Rightarrow$ surface $\equiv$ irregular investment desgrowth from war, then

$$\maltese \quad Y^* \equiv \maltese \pm Y_0 \maltese \quad \maltese \pm \quad Y_1 \quad \maltese \quad \maltese \pm Y_2 \quad \maltese \maltese \pm Y_3$$

$$(15)$$

If $\varDelta Y^* \cap \mathbb{R}_- \Rightarrow$ surface $\equiv$ full investment desgrowth from war, then

$$\maltese - \quad Y^* \equiv \maltese - Y_0 \quad \maltese \quad \maltese - \quad Y_1 \quad \maltese \quad \maltese - Y_2 \quad \maltese \maltese$$
$$- Y_3$$

$$(16)$$

3.2. Findings

The authors employed experimental data and quantitative data from the World Bank. The authors used 635 sub-variables to build the model algorithm. The authors run 5300 random and fuzzy simulations based on different Russian-Ukraine conflict scenarios to identify the drivers of potential economic impact in an extended time framework (2010–2021). All equations in this model were transformed in a large algorithm using Mathematica Wolfram version 12 language programming that generates a large pool of possible results for the problem at hand.

The proposed analytical framework evaluates the trade balance between the European Union and Russian Federation under trade suffocation. The model examines the final trade suffocation index ($T_{S\text{-}Index}$) and the final investment desgrowth ($-\delta_w$) impact on the agriculture exports, industrial and manufacturing exports, services exports, and FDI flows. The simulation findings are summarized in Figure 4.

Trade suffocation findings reveal asymmetric trajectories in the macroeconomic dynamics of the two parties. Investment desgrowth significantly affects factor endowments and productivity, trade policy, exchange rates, foreign currency reserves, inflation, and demand. The trade suffocation rate for the European Union and the Russian Federation is 0.60 and 0.99, respectively. Trade suffocation reverses macroeconomic dynamics: reciprocal sanctions measures lead to macroeconomic and distributional asymmetric consequences (Bhagwati, 1977; Diez, 2010; Johansen, 2010; MacPhee & Rosenbaum, 1989). In the short run, the reciprocal sanctions substantially affect the factors of production with negative implications on social welfare. Changes in the prices of imported goods represent shifts in the composition of current consumption, altering the intertemporal allocation of aggregate consumption. Furthermore, market changes reflect will increase exchange rate volatility.[8] In the long run, ceteris paribus, self-correcting market mechanisms diminish bilateral trade imbalances as both economies achieve suboptimal symmetric equilibria.

Trade suffocation affirms that EU-Russia trade relations are subject to economic inter-dependence.[9] Empirical evidence shows that bilateral trade results in a reduced likelihood of conflict[10] (Gasiorowski & Plachek, 1982; Gasiorowski, 1986; Oneal, Oneal, Maoz, & Russett, 1996; Polachek, 1980, 1992; Sayrs, 1990). The aforementioned findings are consistent with symmetric trade dependence, whereas asymmetric trade dependence is subject to tensions and conflict interactions (Barbieri, 1996). If trade dependency is related to geographic and resource asymmetry, then the loss of commercial power will raise national security concerns and pre-emptive conflict incentives (Morelli & Sonno, 2017). Regionally, a military conflict can be contagious to neighboring states causing a direct spillover effect (Herge & Sambanis, 2006). It explains the European Union's decision to support Ukraine for geopolitical reasons rather than economic reasons.
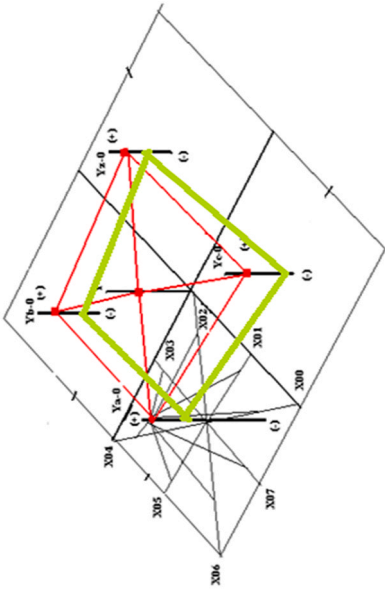
In contrast, the overall investment desgrowth for the European Union and the Russian Federation is − 0.73 and − 0.47. The investment desgrowth for the European Union and the Russian Federation at the sector level are: (i) industrial and manufacturing (−0.72 and −0.73); (ii) agriculture (−0.83 and −0.89); (iii) services (−0.77 and −0.89); and (iv) FDI Flows (−0.97

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[8] Empirical results show a positive asymmetry in exchange rate fluctuations (i.e., depreciation has a greater effect than appreciation) (Rzayeva, 2017).

[9] Economic interdependence theory states that the extensive bilateral trade decreases the likelihood of potential conflicts between the mutually dependent trading partners in the future (Einstein, Jan 7, 2017).

[10] Economic dependence may increase conflict (i.e., between topdogs and underdogs)(Wallenstein, 1973).
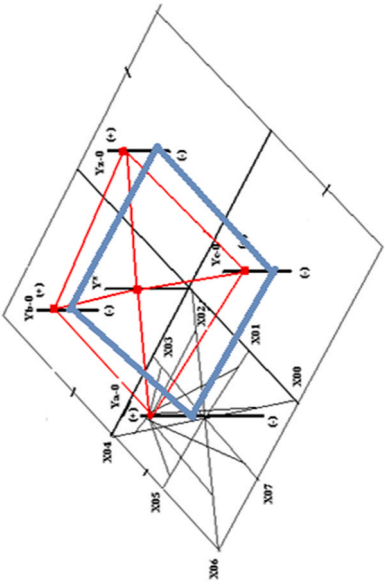
Fig. 4. European Union and Russian Federation $T_{S\text{-}Index}$ and the $(-\delta_w)$ Function.
Source: Authors' elaboration.

and −0.88). The opposite symmetry in investment desgrowth behavior translates into substantial market contraction for the European Union economies than the Russian economy in the short run. Both parties will seek import diversification in an attempt to restore trade stability at the pre-embargo market levels. Import diversification constitutes an indicator of balanced economic growth, given the degree of diversity in substitute goods and the productive capacity of alternative supply chains[11] (Colantone & Crino, 2014; Halpern, Koren, & Szeidl, 2015; Jaimovich, 2012; Kasahara & Rodrigue, 2008). The absence of alternative supply chains[12] will increase economic interdependence, threatening the economic and political autonomy of the dependent country[13](Hirschman, 1980; Keohane & Nye, 1977).

4. Concluding remarks

The effectiveness of European Union economic sanctions to the Russian Federation has two parts: the extent to which the policy result sought by the European Union was in fact achieved and the contribution to success made by sanctions. It has to be acknowledged that assessment of the policy outcomes entails subjective evaluation. Policy objectives are subject to multi-dimensionality since objectives evolve, so sanctions' contribution to the policy outcomes becomes complicated. However, the analysis of this paper has minimized the bias resulting from the authors' personal views.

This paper establishes conceptual foundations for analyzing the economic dimensions of a military conflict. The paper introduces the concept of trade suffocation, and investment desgrowth, new economic phenomena to explain the uncharted territory of economic sanctions and their consequences on the affected economies. The model quantifies the vulnerability level of the European Union economies due to trade and investment interdependence. Findings indicate that high levels of trade suffocation significantly affect macroeconomic foundations in both parties in the short run.

Undoubtedly, the Russo-Ukraine conflict will reshape international trade and reconsider global value chains. Preserving stable and coordinated international trade relations will be imperative to avoid future catastrophic disorders or disputes. Searching for alternatives will be a gradual rather than sudden process, given the socioeconomic differentials across countries. It is prudent to assume that reverse globalization and the emergence of semi-autonomous regional blocs will decentralize value chains and improve trade efficiency.

ITDW-Simulator offers policymakers, central banks, academics, and students an alternative multi-dimensional graphical modeling approach to analyze the impact of the economic sanctions on bilateral trade from a multi-dimensional perspective. This study's multi-dimensional approach needs to be explored further to realize its full potential. The classic two-dimensional Euclidean configuration carries mathematical and graphical limitations that fail to capture all possible trade market equilibria. It is, therefore, necessary to continue the empirical validation

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[11] Empirical evidence shows that several countries worldwide, including Argentina, Australia, Brazil, France and United Kingdom can meet Chinese Market demands for agriculture products if China needs substitutes for U.S. goods (Albuquerque, 2019; Tu, Du, Lu, & Lou, 2020; Turak, 2018)

[12] Shortages of semiconductors due to Covid-19 and geopolitical tensions with China have been hurting American manufacturing, communications, computing, health care, transportation illustrating the need for the United States to enhance self-sufficiency in semis production (Kharpal, 2021; Werlin, 2021).

[13] Russia's has leveraged Ukraine's energy dependence on natural gas to influence or control the country's political and economic development (Klid, March 28, 2020; Shi, 2009; Smith, 2008; Stulberg, 2017)

exercises by considering professional subjects, designing new experiments with more cases and different algorithms, and running case studies with actual data from the economic environment to ensure conclusion validity.

References

Adam, A., & Tsarsitalidou, S. (2019). Do sanctions lead to a decline in civil liberties? *Public Choice, 180*(34), 191–215.

Albuquerque, F. W. (April 17, 2019). The Short-Term Effects of Trade Tariffs. Ekonamik - Nordic Macroeconomic Intelligence. Retrieved from ⟨http://ekonamik.com/2019/04/the-short-term-effects-of-the-trade-tariffs/⟩.

Amuzegar, J. (1997). Adjusting to sanctions. *Foreign Affairs, 76*(3), 31–41.

Ankudinov, A., Ibragimov, R., & Lebedev, O. (2017). Sanctions and the Russian stock market. *Res. Int. Bus. Finance, 40*(C), 150–162.

Baldwin, D. A. (1985). *Economic statecraft.* Princeton, NJ: Princeton University Press.

Bapat, N. A., Heinrich, T., Kobayashi, T., & Morgan, C. T. (2013). Determinants of sanctions effectiveness: sensitivity analysis using new data. *International Interactions, 39*(1), 79–98.

Bapat, N. A., & Morgan, C. T. (2009). Multilateral versus unilateral sanctions reconsidered: a test using new data. *International Studies Quarterly, 53*(4), 1075–1094.

Barber, J. (1979). Economic sanctions as a policy instrument. *International Affairs, 5*(3), 367–384.

Barbieri, K. (1996). Economic interdependence: a path to peace or a source of interstate conflict? *Journal of Peace Research, 33*(1), 29–49.

BBC News. (May 4, 2022). What sanctions are being imposed on Russia over Ukraine invasion? BBC. Retrieved from ⟨https://www.bbc.com/news/world-europe-60125659⟩.

Besedes, T., Goldbach, S., & Nitsch, V. (2017). You're banned! the effect of sanctions on german cross-border financial flows. *Economic Policy, 32*(90), 263–318.

Bhagwati, J. (1977). *Protectionism.* Cambridge, MA: The MIT Press.

Biglaiser, G., & Lektzian, D. (2011). The effect of sanctions on US foreign direct investment. *International Organization, 65*(3), 531–551.

Black, P. A., & Cooper, H. (1987). On the welfare and employment effects of economic sanctions. *South African Journal of Economics, 55*(1), 1–15.

Bonetti, S. (1998). Distinguishing characteristics of degrees of success and failure in economic sanctions episode. *Applied Economics, 30*(6), 805–813.

Botterill, L. C., & McNaughton, A. (2008). Laying the foundations for the wheat scandal: UN sanctions, private actors and the cole inquiry. *Australian Journal of Political Science, 43*(4), 583–598.

Brzoska, M. (2015). International sanxtions before and beyond UN sanctions. *International Affairs, 91*(6), 1339–1349.

Buchholtz, K. (2022). Where Russia's Attack on Ukraine Was Condemned. In: Statista.

Caruso, P. (2003). The impact of international economic sanctions on trade: an empirical analysis. *Peace Economics, Peace Science and Public Policy, 9*(2), 1–36.

Central Banking Newsdesk. (February 24 2022). Russian central bank announces string of emergency measures. Retrieved from ⟨https://www.centralbanking.com/central-banks/financial-stability/7933271/russian-central-bank-announces-string-of-emergency-measures⟩.

Colantone, I., & Crino, R. (2014). New imported inputs, new domestic products. *Journal of International Economics, 92*(1), 147–165.

Congressional Research Service. (May, 2022). Russia's War on Ukraine: The Economic Impact of Sanctions. Retrieved from ⟨https://crsreports.congress.gov/product/pdf/IF/IF12092⟩.

Connolly, M. (1983). *Exchange rates, real economic activity and the balance of payments: evidence from 1960s.* In C. E. & S. P. (Eds.)*Recent Issues in the Theory of Flexible Exchange Rates.* Amsterdam: North-Holland.

Cotright, D., & Lopez, G. A. (2018). *Economic sanctions: panacea or peacebuilding in a post-cold war world?".* Abingdon, UK: Routledge.

Daoudi, M. S., & Dajani, M. S. (1983). *Economic sanctions: ideal and experience.* Boston, MA: Routledge.

Dashti-Gibson, J., Davis, P., & Radcliff, B. (1997). On the determinants of the success of economic sanctions: an empirical analysis. *American Journal of Political Science, 41*(2), 608–618.

Diez, F. (2010). The Asymmetric Effects of Tariffs on Intra-Firm Trade and Offshoring Decisions. Research Department Working Paper Series No. 10–4. Federal Reserve Bank of Boston. Retrieved from ⟨https://www.bostonfed.org/publications/research-department-working-paper/2010/the-asymmetric-effects-of-tariffs-on-intra-firm-trade-and-offshoring-decisions.aspx⟩.

doxey, M. P. (1980). Economic sanctions: benefits and costs. *World Today, 36*(12), 484–489.

Doxey, M. P. (1987). *International sanctions in contemporary perspectives.* New York: St. Martin's Press.

Dreger, C., Kholodilin, K. A., Ulbright, D., & Fidrmuc, J. (2016). Between the hammer and the anvil: the impact of economic sanctions and oil prices on Russia's ruble. *Journal of Comparative Economics, 44*(2), 295–308.

Drezner, D. W. (1998). Conflict expectations and the paradox of economic coersion. *International Studies Quarterly, 42*(4), 709–731.

Drezner, D. W. (1999). *The sanctions paradox: economic statecraft and international relations.* Cambridge, UK: Cambridge University Press.

Drezner, D. W. (2000). Bargaining, enforcement, and multilateral sanctions: When is cooperation counterproductive? *International Organization, 54*(1), 73–102.

Drezner, D. W. (2003). The hidden hand of economic coersion. *International Organization, 57*(3), 643–659.

Drury, C. A. (1998). Revisiting economic sanctions reconsidered. *Journal of Peace Research, 35*(4), 497–509.

Early, B. R. (2009). Sleeping with your friends' enemies: an explanation of sanctions-busting trade. *International Studies Quarterly, 53*(1), 49–71.

Early, B. R. (2011). Unmasking the black knights: sanctions busters and their effects on the success of economic sanctions. *Foreign Policy Analysis, 7*(4), 381–402.

Early, B. R. (2015). *Busted sanctions: explaining why economic sanctions fail.* Redwood, CA: Stanford University Press.

Early, B. R., & Spice, E. (2015). Economic sanctions, international institutions, and sanctions busters: when does institutionalized cooperation help sanctioning efforts? *Foreign Policy Analysis, 11*(3), 339–360.

Einstein, J. (Jan 7 2017). Economic Interdependence and Conflict - The Case of the US and China. E-International Relations. Retrieved from ⟨https://www.e-ir.info/2017/01/17/economic-interdependence-and-conflict-the-case-of-the-us-and-china/⟩.

European Commission. (2022b). Russia: EU trade relations with Russia. Facts, figures and latest developments. Retrieved from ⟨https://policy.trade.ec.europa.eu/eu-trade-relationships-country-and-region/countries-and-regions/russia_en#:~:text=In%202020%2C%20the%20EU%20was,amounted%20to%20%E2%82%AC257.5%20billion⟩.

European Commission. (2022a). EU trade relations with Russia. Facts, figures and latest developments. Retrieved from ⟨https://policy.trade.ec.europa.eu/eu-trade-relationships-country-and-region/countries-and-regions/russia_en#:~:text=In%202020%2C%20the%20EU%20was,amounted%20to%20%E2%82%AC257.5%20billion⟩.

Eurostat. (2022). Energy represented 62 % of EU imports from Russia. In.

Evenett, S. J. (2002). The impac of economic sanctions on South African Exports. *Scottish Journal of Political Economy, 49*(5), 557–573.

Galtung, J. (1967). On the effects of international economic sanctions: with examples from the case of rhodesia. *World Politics, 19*(3), 378–416.

Gasiorowski, M. (1986). Economic interdependence and international conflict: some cross-national evidence. *International Studies Quarterly, 30*(1), 23–28.

Gasiorowski, M., & Plachek, S. W. (1982). Conflict and interdependence: east-west trade and linkages in the era of detente. *Journal of Conflict Resolution, 26*(4), 709–729.

Gharehgozli, O. (2017). An estimation of the economic cost of recent sanctions on iran using the synthetic control method. *Economic Letters, 157*(August), 141–144.

Giumelli, F. (2011). *Coercing, constraining and signalling: explaining UN and EU sanctions after the cold war.* Colchester, UK: ECPR Press.

Gleick, J. (1988). *Chaos: making a new science.* New York: Penguin Books Press.

Glick, R., & Taylor, A. M. (2010). Collateral damage: trade disruption and the economic impact of war. *The Review of Economics and Statistics, 92*(1), 102–127.

Gontmakher, E. (December 2, 2021). Russia's import substitution: Effects and consequences. Geopolitical Intelligence Services. Retrieved from ⟨https://www.gisreportsonline.com/r/import-substitution/⟩.

Gurvich, E., & Prilepsky, I. (2015). The impact of financial sanctions on the Russian economy. *Russian Journal of Economics, 1*(4), 359–385.

Gylfason, T., & Risager, O. (1984). Does devaluation improve the current account? *European Economic Review, 25*(1), 37–64.

Gylfason, T., & Schmid, M. (1983). Does devaluation cause stagflation? *Canadian Journal of Economics, 16*(4), 641–654.

Halpern, L., Koren, M., & Szeidl, A. (2015). Imported inputs and productivity. *American Economic Review, 105*(12), 3660–3703.

Herge, H., & Sambanis, N. (2006). Sensitivity analysis of empirical results on civil war onset. *Journal of Conflict Resolution, 50*(4), 508–535.

Hirschman, A. O. (1980). *National power and the structure of foreign trade.* Berkeley & Los Angeles: University of California Press.

Hoffmann, F. (1967). The functions of economic sanctions: a comparative analysis. *Journal of Peace Research, 4*(2), 140–160.

Hufbauer, G., Schott, J., & Elliott, K. A. (1990). *Economic Sanctions Reconsidered: History and Current Policy* (2nd ed.). Washington, D.C: Institute for International Economics.

Hufbauer, G., Schott, J., Elliott, K. A., & Oegg, B. (2007). *Economic Sanctions Reconsidered: History and Current Policy.* Washington, D.C.: Patterson Institute for International Economics.

Jaimovich, E. (2012). Import diversification along the growth path. *Economic Letters, 117*(1), 306–310.

Jeong, J. M., & Peksen, D. (2019). Domestic institutional constraints, veto players, and sanction effectiveness. *Journal of Conflict Resolution, 63*(1), 194–217.

Johansen, N. (2010). Imperfect tax competition for profits, asymmetric equilibrium and beneficial tax havens. *Journal of International Economics, 81*(2010), 253–264.

Kasahara, H., & Rodrigue, J. (2008). Does the use of imported intermediates increase productivity? Plant-level evidence. *Journal of Development Economics, 87*(1), 106–118.

Keohane, R., & Nye, J. (1977). *Power and Interdependence: World Politics in Transition.* Boston: Little Brown.

Kharpal, A. (April 11, 2021). How Asia came to dominate chipmaking and what the U.S. wants to do about it. Retrieved from ⟨https://www.cnbc.com/2021/04/12/us-semiconductor-policy-looks-to-cut-out-china-secure-supply-chain.html⟩.

Klid, B. (March 28, 2020). Time for Ukraine to exit Russia's energy empire. Atlantic Council. Retrieved from ⟨https://www.atlanticcouncil.org/blogs/ukrainealert/time-for-ukraine-to-exit-russias-energy-empire/⟩.

LeBaron, B. (1994). Chaos and nonlinear forecastability in economics and finance. *Philosophical Transactions: Physical Sciences and Engineering, 348*(1688), 397–404.

Lektzian, D., & Biglaiser, G. (2013aaa). Investment, opportunity, and risk: do US sanctions deter or encourage global investment? *International Studies Quarterly, 57*(1), 65–78.

Lektzian, D., & Biglaiser, G. (2013bbb). Investment, opportunity, and risk: do US sanctions deter or encourage global investment? *International Studies Quarterly, 57*(1), 65–78.

Lindsay, J. M. (1986). Trade sanctions as policy instruments: a re-examination. *International Studies Quarterly, 30*(2), 153–173.

MacPhee, C. R., & Rosenbaum, D. I. (1989). The asymmetric effects of reversible tariff changes under the United States GSP. *Southern Economic Journal, 56*(1), 105–125.

Martin, L. L. (1992). *Coercive cooperation: explaining multilateral economic sanctions.* Princeton, NJ: Princeton University Press.

Mastanduno, M. (1999). Economic statecraft, interdependence, and national security: agendas for research. *Security Studies, 9*(1), 288–316.

Mellor, S. (May 4 2022). Europe's proposed ban on Russian oil could leave Moscow scrapping for $70 a barrel on a good day. Fortune. Retrieved from ⟨https://fortune.com/2022/05/04/europe-eu-proposed-ban-russian-oil-moscow-scrapping-70-barrel-india/⟩.

Miers, A., & Morgan, C. T. (2002). Multilateral sanctions and foreign policy success: can too many cooks spoil the broth? *International Interactions, 28*(2), 117–136.

Morelli, M., & Sonno, T. (2017). On economic interdependence and war. *Journal of Economic Literature, 55*(3), 1084–1097.

Morgan, C. T., Barat, N., & Kobayashi, Y. (2014). Threat and imposition of economic sanctions 1945–2005: Updating the TIES dataset. Retrieved from: ⟨https://journals.sagepub.com/doi/abs/10.1177/0738894213520379⟩.

Neuenkirch, M., & Neumeier, F. (2015). The impact of UN and US economic sanctions on GDP growth. *European Journal of Political Economy, 40*(December), 110–125.

Ninsic, M., & Wallenstein, P. (1983). *Dilemmas of economic coersion: sanctions in world politics.* New York: Praeger.

Nossal, K. R. (1989). International sanctions as international punishment. *International Organization, 43*(2), 301–322.

Office of the high Commisioner for human rights. (2022). Ukraine: civilian casualty update 13 May 2022 [Press release]. Retrieved from ⟨https://www.ohchr.org/en/news/2022/05/ukraine-civilian-casualty-update-13-may-2022⟩.

Oneal, J. R., Oneal, F., Maoz, Z., & Russett, B. (1996). The liberal peace: interdependence, democracy and international conflict, 1950-1986. *Journal of Peace Research, 33*(1), 11–28.

Ortiz, E. (Feb. 2022). SWIFT banking system could be used as sanctions against Russia. What it is? NBC News. Retrieved from ⟨https://www.nbcnews.com/news/world/swift-banking-system-used-sanction-russia-rcna17533⟩.

O'Sallivan, M. L. (2010). Iran and the great sanctions debate. *The Washington Quarterly, 33*(4), 7–21.

Pape, R. (1997). Why economic sanctions do not work. *International Security, 22*(2), 90–136.

Peksen, D. (2009). Better or worse? the effect of economic sanctions on human rights. *Journal of Peace Research, 46*(1), 59–77.

Peksen, D., & Byunghwan, S. (2015). Economic coersion and currency crisis in target countries. *Journal of Peace Research, 52*(4), 448–462.

Peksen, D., & Drury, C. A. (2010). Coersive or corrosive: the negative impact of economic sanctions on democracy. *International Interactions, 36*(3), 240–264.

Peksen, D., & Peterson, M. T. (2016). Sanctions and alternate markets how trade and alliances affect the onset of economic coersion. *Political Research Quarterly, 69*(1), 4–16.

Polachek, S. W. (1980). Conflict and trade. *Journal of Conflict Resolution, 24*(1), 57–78.

Polachek, S. W. (1992). Conflict and trade: an economic approach to political international interactions. In W. Isard, & C. H. Anderson (Eds.). *Economics of Arms Reduction and the Peace Process*. Amsterdam: North-Holland.

Ruiz Estrada, M. A. (2010). Economic Desgrowth. Retrieved from https://ssrn.com/abstract=1857277 doi:10.2139.

Ruiz Estrada, M. A. (2009). Multi-dimensional Economic Modeling. FEA - Working Paper No.2009–7. Faculty of Economics and Administration, University of Malaya.

Ruiz Estrada, M. A. (2011a). Multi-dimensional coordinate spaces. *Int. J. Phys. Sci. 6*(3), 340–357.

Ruiz Estrada, M. A. (2011b). Policy modeling: definition, classification and evaluation. *Journal of Policy Modeling, 33*(4), 523–536.

Ruiz Estrada, M. A. (2017). An alternative graphical modeling for economics: econographicology. *Quality and Quantity Journal, 51*(5), 2115–2139. https://doi.org/10.1007/s11135-015-0280-3

Ruiz Estrada, M. A., & Koutronas, E. (2016). Terrorist attack assessment: Paris November 2015 and Brussels March 2016. *Journal of Policy Modeling, 38*(3), 553–571. https://doi.org/10.1016/j.jpolmod.2016.04.001

Ruiz Estrada, M. A., & Yap, S. F. (2013). The origins and evolution of policy modeling. *Journal of Policy Modeling, 35*(1), 170–182.

Rzayeva, U. (2017). Asymmetric changes in the world economy. *Journal of Economics and Finance, 8*(3), 39–46.

Sayrs, L. W. (1990). Expected utility and peace science: an assessment of trade and conflict. *Conflict Management and Peace Science, 11*(1), 17–44.

Seybolt, T.B. (2007). Humanitarian Military Intervention: The Conditions for Success and Failure. Great Clarendon Street, Oxford OX2 6DP: Oxford University Press.

Shi, C. (2009). Perspective on natural gas crisis between Russia and Ukraine. *Review of European Studies, 1*(1), 56–60.

Shin, G., Choi, S.-W., & Luo, S. (2015). Do economic sanctions impair target economics? *International Political Science Review, 37*(4), 485–499.

Smith, K. C. (2008). Russian Energy and Its Challenge to Western Policy Makers. Retrieved from ⟨https://csis-website-prod.s3.amazonaws.com/s3fs-public/legacy_files/files/media/csis/pubs/080407_helsinki.pdf⟩.

Stulberg, A. N. (2017). Natural gas and the Russia-Ukraine crisis: strategic restraint and the emerging Europe-Eurasia gas network. *Energy Research & Social Science, 24*(2017), 71–85.

Tu, X., Du, Y., Lu, Y., & Lou, C. (2020). US-China trade war: is winter coming for global trade? *Journal of Chinese Political Science, 25*(2), 199–240.

Turak, N. (2018). The countries that could actually benefit from China's trade tariffs on the US. CNBC. Retrieved from ⟨https://www.cnbc.com/2018/04/06/the-countries-that-could-benefit-from-chinas-trade-tariffs-on-the-us.html⟩.

Van Bergeijk, P. A. G. (1989). Success and failure of economic sanctions. *Kyklos, 42*(3), 385–404.

Van Bergeijk, P. A. G. (1995). The impact of economic sanctions in the 1990s. *The World Economy, 18*(3), 443–455.

Verma, M. (February 28, 2022). Russia's central bank is preparing for hyperinflation. Quartz. Retrieved from ⟨https://qz.com/2134814/russian-central-bank-raises-interest-rate-to-20-percent-as-ruble-crashes/⟩.

Wallenstein, P. (1968). Characteristics of economic sanctions. *Journal of Peace Research, 5*(3), 248–267.

Wallenstein, P. (1973). *Structure and war: on international relations 1920-1968*. Stockholm: Raben & Sjogren.

Werlin, E. (January 19, 2021). DOC'S PRESCRIPTION: Semiconductors play pivotal role in U.S. economy. Herald-Tribune. Retrieved from ⟨https://www.heraldtribune.com/story/business/2021/01/19/ernest-werlin-semiconductors-play-pivotal-role-u-s-economy/4202567001/⟩.

Whang, T. (2010). Structural Estimation of Economic Sanctions: From Initiation to Outcomes. *Journal of Peace Research, 47*(5), 561–573.

Wilmott, P. (2009). *Frequently Asked Questions in Quantitative Finance* (2nd ed.). Chichester, UK: John Willey & Sons.

Wilson, W. (1919). *Address At Coliseum, Indianapolis, Indiana, September 4, 1919. Addresses of President Wilson*. Washington D.C.: Government Printing Office,21–28.

Wood, R. M. (2008). A hand upon the throat of the nation: economic sanctions and state represantion, 1976-2001. *International Studies Quarterly, 52*(3), 489–513.

World Trade Organization. (March 16, 2020). DS521: European Union - Anti-Dumping Measures on Certain Cold-Rolled Flat Steel Products from Russia [Press release]. Retrieved from ⟨https://www.wto.org/english/tratop_e/dispu_e/cases_e/ds521_e.htm⟩.

Yang, J., Askari, H., Forrer, J., & Teegen, H. (2004). US economic sanctions against China: Who gets Hurt? *World Economy, 27*(7), 1047–1081.